
NEW BOOKS

The Methodology of Pierre Duhem. By ARMAND LOWINGER. Columbia University Press, Morningside Heights, New York, N. Y., 1941. 184 pp. 14.5 × 22 cm. Price, \$2.25.

The chief interest in this book will be found, I venture to think, not in those ideas of Duhem which it expounds, but in the glimpse it gives of Duhem's psychology. There are aspects of Duhem's writings which are still of much intrinsic interest; he is to be credited with some of the best history of physics that has been written, and in thermodynamics he did pioneering work with the thermodynamic potentials. Lowinger's book, however, is mostly concerned with the ideas in Duhem's book "La Théorie physique, son objet et sa structure."

Duhem belonged to the energetic school of thermodynamics of Ostwald which insisted on the fundamental role of energy and the unjustifiability of the atoms of the chemist. Part of Duhem's methodology is motivated by the desire to justify this point of view. As a consequence, many of Duhem's critical comments make edifying reading even today, because there can be no doubt that at the time of Ostwald and Duhem the atomistic point of view had been pushed further than could be justified by knowledge then extant. In fact, this still seems to me to a certain extent true with regard to statistical mechanics and quantum theory. But in spite of this aspect of Duhem's methodology with which one must sympathize, I believe the average reader will find that the entire structure produces a singularly disquieting effect. There seems to be a lack of singleness of purpose. One does not see why Duhem was so concerned that physical methodology must give heed to certain considerations which are apparently irrelevant. The so-called "autonomy of physics," on which Duhem insists so much and which at first seems so commendable, turns out to mean that physics must keep within its own field because there is another field from which it must keep out, namely, the field of metaphysics. The whole climate of the book is colored by this prepossession, and Lowinger does nothing to help the reader to understand it. The reader will understand it only when he recalls that Duhem was a Catholic and an ardent Thomist; Lowinger makes only a single oblique reference in a single sentence to this so important fact. This omission seems so surprising as to be hardly accidental, and I could not help wondering whether Lowinger himself does not to a certain extent accept Duhem's sentiments.

The final chapter of criticism by Lowinger of Duhem's methodology makes one point which I think most readers will accept as just, namely, that the whole enterprise of methodology as Duhem expounds it is putting the cart before the horse. One does not extract from his inner consciousness a methodology to which physics must conform, but rather methodology cannot arise until there is a body of successful scientific practise for it to analyze, and its function is to systematize procedures which we already know will work.

P. W. BRIDGMAN

Photography, its Principles and Practice. By C. B. NEBLETTE, F.R.P.S., Counselor and Administrative Head, Department of Photographic Technology, Rochester Athenaeum and Mechanics Institute, etc. Fourth edition. With Chapters by Ralph H. Braden, Department of Chemistry, Howard C. Colton and Silas M. Thronson, Department of Photographic Technology, Rochester Athenaeum and Mechanics Institute, and J. W. Gillon, Development Department, Eastman Kodak Company. D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, N. Y., 1942. xii + 865 pp. Illustrated. 15.5 × 23.5 cm. Price, \$7.50.

The previous edition has been greatly expanded and extensively revised. The sections on photographic practice are now quite sharply separated from those dealing with theory, the less to torment those who lack an elementary knowledge of chemistry, physics and logarithms. Four new authors have assumed responsibility for separate sections as follows: color sensitizing and dyes for photographic emulsions by Ralph H. Braden; photographic optics, flashlamps and synchronizers, also reproduction of tone, by J. W. Gillon; photochemistry and the theory of development by Silas M. Thronson; photography in colors by Howard C. Colton. Each of these subjects is thoroughly brought up to date, and is ably coordinated with the rest of the work. Numerous references to journal articles will tempt a few readers to go further still. Common and uncommon photographic operations alike are described with a wealth of expert detail. The text seems to anticipate every obstacle and forestall every error. It would be difficult indeed to criticize or to suggest improvements in any of these respects.

And yet in the last analysis imagination counts for more than equipment and artistry for more than processing. Much could be gained by inclusion of such topics as composition and portraiture, followed by demonstrations of the possibilities latent in the scenes and events of everyday life. This done, the paper cover will have made good its boast—"A thorough treatment of photography, solving every pertinent problem and answering every practical question."

GEORGE S. FORBES

Introduction to Chemical Thermodynamics. By LUKE E. STEINER, Associate Professor of Chemistry, Oberlin College. McGraw-Hill Book Company, Inc., New York, N. Y., 1941. vii + 516 pp. 38 figs. 16.5 × 23.5 cm. Price, \$4.00.

In the Preface the author has announced three objectives for this book which is designed as a textbook for college seniors and first-year graduate students having no previous knowledge of thermodynamics. The first is to acquaint the student with the fundamental theories of thermodynamics; the second, to train him in the use of tables and thermodynamic data in the current literature; and the third, to provide him with a proper basis for future

study in this field. The text assumes no knowledge of mathematics beyond what would be obtained in a year's study of the calculus. The mathematical approach is direct and extremely full. The author points out that this method is followed in order to enable a greater proportion of the student's time to be spent in classroom discussion, certainly an aid in obtaining a sound foundation. Lewis and Randall's nomenclature is used throughout, as it is in most American books in this field.

Sets of problems, giving the student an opportunity to apply the principles developed, are appended to each chapter. These problems require the student to find current thermodynamic data and to apply them correctly. For this purpose many references are given to the original literature in such readily available sources as THIS JOURNAL. These arrangements certainly lead to the author's second objective. Unfortunately, many of the problems are of the formula-substitution type that offer little training to the student in the exercise of his logical faculties.

All of the customary topics are covered in twenty-one chapters, including general equilibrium conditions, non-ideal solutions, partial molal quantities, and solutions of electrolytes. Treatment of the third law is necessarily brief and contains no discussion of spectroscopic or statistical methods. Perhaps the outstanding objection that can be raised to the organization of the material is the puzzling break in the treatment of entropy and the second law. Separation into more than one chapter seems to introduce some mental barriers for the beginner that are difficult to surmount.

The typography is clear and easily read. Only a few typographical errors have been noted and these can readily be remedied when reprinting becomes necessary. The binding is the customary one of the volumes in the International Chemical Series, substantial but not very attractive. A good index, a table of all symbols used, and an appendix containing useful numerical data are included.

The author clearly gains his objective with this volume and it can be well recommended as an elementary textbook of thermodynamics.

WILLARD M. BRIGHT

Semimicro Qualitative Analysis. By PAUL ARTHUR, Ph.D., Associate Professor of Chemistry, and OTTO M. SMITH, Ph.D., Professor of Chemistry, Oklahoma Agricultural and Mechanical College. Second edition. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N. Y., 1942. xi + 322 p. Illustrated. 15.5 × 23.5 cm. Price, \$2.75.

The first edition of this excellent book emphasized laboratory procedure with a minimum of theory. The new, greatly improved edition gives much more attention to the pertinent theories of Physical Chemistry than it does to the details of laboratory procedure. Modern theories are, in general, treated adequately for beginners. The Brönsted acid-base theory is explained but throughout the book the older conception of *hydrogen* rather than *hydronium* ions is retained for the logical reason that when emphasis is placed on the hydration of hydrogen ions, considerable attention should likewise be paid to that of many other ions. Even Werner's valence theory is discussed

intelligently. Of the theoretical discussions, which comprise about two-thirds of the book, it can be said that the treatment is adequate.

The specific tests given in the analytical procedure are well chosen. Comparatively little attention, however, is paid to the matter of interference. Thus in the analysis of Groups III and IV of cations no emphasis is placed upon the fact that the presence of phosphate, oxalate or fluoride may cause precipitation of Group IV upon the addition of ammonia to the filtrate from Group II. With respect to the quantities of material, the directions are vague. Of solids the student is told to take "a volume of solid the size of a large match head" and of solutions to use "1 ml. of solution" which may be 0.01 molar or may contain 10 mg. per ml. as the instructor may choose.

The book is clearly written, the new addition contains many improvements and the numerous study questions will serve to make it useful for class room instruction.

WILLIAM T. HALL

Calculations of Qualitative Analysis. By CARL J. ENGELDER, Ph.D., Professor of Analytical Chemistry, University of Pittsburgh. Second Edition. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1942. x + 174 pp. 15 × 23 cm. Price, \$2.00.

In the second edition of this well-known text Professor Engelder has adhered to the purpose of the first edition, "namely, to provide the fundamental theory of equilibrium calculations as applied to ionic reactions and to furnish sets of problems for home and classroom use, arranged in 15 weekly assignments."

The book comprises ten chapters that deal with the solution of problems pertaining to the various types of ionic equilibria encountered in qualitative analysis, as follows: I, Mathematical Operations; II, Stoichiometric Calculations Based on Chemical Equations; III, The Preparation and Use of Reagents; IV, Molar and Gram-Ion Concentrations; V, Ionization Equilibria; VI, Solubility Product Equilibria; VII, Complex-Ion Equilibria; VIII, Hydrolysis Equilibria; IX, Oxidation-Reduction Equilibria; and X, General Summary and Review. Each chapter ends with an extensive set of problems, and answers are supplied to alternate problems. The method of treatment follows classical practice in most respects and is thorough in its practical details.

It is unfortunate, however, that the author has chosen to retain the concept of "degree of dissociation" for strong electrolytes with its attendant ambiguities. For example in Table II on p. 52 values are given for the "percentage ionization" of such electrolytes as hydrochloric acid, potassium chloride, *et cetera*, and yet in a footnote to Table IV on p. 58 the student is told that the degree of ionization of such substances is too great to yield an ionization constant! No explanation is offered for this unique behavior of strong electrolytes, and the student is left by himself to cope with the anomalies. The interpretation of electrode potentials in terms of "solution pressure constants" on p. 135 *et seq.* also leads to some rather fantastic conclusions. For example, on p. 142 it is concluded erroneously from the standard potential of the reaction $2I^- = I_2 + 2e$ that the "equilibrium ratio $C_{I_2}/(C_{I^-})^2$ " is equal to 5×10^{-19} , with-

out mention of the fact that this is actually the value of the equilibrium constant of the reaction $2\text{H}^+ + 2\text{I}^- = \text{I}_2 + \text{H}_2$. This section of the text would be greatly improved by a more modern treatment. The discussions of various other types of ionic equilibria also suffer from oversimplification and neglect of important concurrent equilibria. For example, on p. 79 the solubility products of silver phosphate and lead phosphate calculated from the molar solubilities of these salts are incorrect because the hydrolysis of the phosphate ion has been ignored. Similarly on p. 80 it is stated that the concentrations of calcium and carbonate ions are equal in a saturated solution of calcium carbonate, in spite of the fact that the hydrolysis of the carbonate ion is so great at this small concentration that bicarbonate ion is actually the predominant anion. Also on p. 105 it is stated that the concentration of cyanide ion in a 0.1 *M* solution of $\text{K}_2\text{Cu}(\text{CN})_6$ is three times the concentration of cuprous ion, and equal to 1.1×10^{-7} *M*, whereas actually at this small concentration the hydrolysis of the cyanide ion is so complete that its concentration is several orders of magnitude *smaller* than the concentration of cuprous ion.

The reviewer's general impression of the book is that it will be useful chiefly for teaching the mechanical details of stoichiometric and equilibrium calculations.

JAMES J. LINGANE

Analytical Chemistry. Based on the German Text of F. P. Treadwell. Enlarged and Revised by WILLIAM T. HALL of the Massachusetts Institute of Technology. Volume II. Ninth English Edition. John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y., 1942. xi + 806 pp. 121 figs. 15.5×23.5 cm. Price, \$6.00.

Before examining this new, revised edition of a well-known textbook, the reviewer made a private guess as to how much the contents and format of this edition would differ from those of the previous, eighth edition. The reviewer's guess that there would be a considerable change was based in part on the following statement in the preface:

"The (revised) manuscript originally submitted to the publisher was so long that it seemed best to go over it again and by deletions and condensations bring the book back to the size of the eighth edition. As much old material has been dropped, not without some misgivings, as new material has been introduced. Thus the introduction of a new procedure developed at the National Bureau of Standards for the determination of six metals of the platinum group meant the rejection of the classic procedure of Deville and Stas, which was certainly of historical interest."

But the reviewer's guess was wrong. The book, although changed in many ways, still has the long familiar flavor of the earlier editions. The reviewer realizes now that the last sentence in the above quotation is the key to the spirit of the present revision.

In spite of the omission of some of the newer analytical methods this book still has an important place as a valuable collection of standard analytical procedures. Yet as a textbook for students, the book has the shortcoming of not having as much theoretical discussion as one expects

and is accustomed to find in such books nowadays. From the standpoint of the student, there are also other objectionable points. For example, the design of transfer pipets is given on page 434, and the technique of manipulating them in the directions for their calibration on page 442. The use and general utility of transfer pipets in quantitative analysis are, however, not brought out until page 555 where they are discussed as part of the procedure of the Williams Method for manganese.

ARTHUR F. SCOTT

BOOKS RECEIVED

January 10, 1943–February 10, 1943

ARTHUR TALBOT BAWDEN. "Man's Physical Universe." Revised edition. The Macmillan Company, 60 Fifth Avenue, New York, N. Y. 832 pp. \$4.00.

JULES BEBIE. "Manual of Explosives, Military Pyrotechnics and Chemical Warfare Agents." The Macmillan Company, 60 Fifth Avenue, New York, N. Y. 171 pp. \$2.50.

E. J. BOWEN. "The Chemical Aspects of Light." Oxford University Press, 114 Fifth Avenue, New York, N. Y. 186 pp. \$4.00.

WILLIAM C. BOYD. "Fundamentals of Immunology." Interscience Publishers, Inc., 215 Fourth Avenue, New York, N. Y. 446 pp. \$5.50.

WILLIAM T. CALDWELL. "Organic Chemistry." Houghton Mifflin Company, 2 Park Street, Boston, Mass. 763 pp. \$4.25.

LYMAN CHALKLEY. "Technology and the Economics of Total War." American Council on Public Affairs, Washington, D. C. 24 pp. \$0.25.

M. L. CROSSLEY, *et al.*, Editors. "Archives of Biochemistry." Volume I, No. 2, December, 1942. Academic Press, Inc., 125 E. 23rd Street, New York, N. Y. 159 pp. 2 volumes yearly at \$5.50 per volume.

HENRY GILMAN, Editor-in-Chief. "Organic Chemistry." Volumes I and II. Second edition. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 1982 pp. \$7.50 each.

BENJAMIN HARROW. "Textbook of Biochemistry." Third edition, revised. W. B. Saunders Company, Philadelphia, Pennsylvania. 537 pp. \$4.00.

YANDELL HENDERSON AND HOWARD W. HAGGARD. "Noxious Gases." (A. C. S. Monograph.) Second, revised edition. Reinhold Publishing Corporation, 330 West 42nd Street, New York, N. Y. 294 pp. \$3.50.

ARTHUR R. MIDDLETON AND JOHN W. WILLARD. "Semi-micro Qualitative Analysis." Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y. 254 pp. \$3.75 (Special Edition for Schools, \$2.75).

"Abridged Scientific Publications from the Kodak Research Laboratories." Vol. XXIII, 1941. Eastman Kodak Company, Rochester, New York. 283 pp.